1 D [1]

2 D [1]

3 **a)** **G** – epidermis ;

H – xylem ;

J – phloem ; [3]

b) *these points can be taken from a labelled diagram – see below*

vascular tissue is central, not peripheral ;

xylem in the centre ;

xylem is star-shaped / AW ;

xylem is surrounded by areas of phloem ;

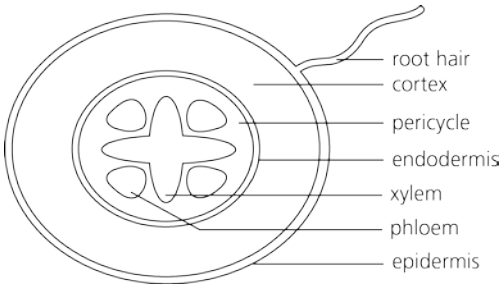
vascular tissue is surrounded by pericycle ;

vascular tissue is surrounded by endodermis ;

Casparian strip in the endodermis ;

cortex (made of parenchyma tissue) and epidermis ;

root hair cells in epidermal layer ;



[5]

c) *3 max if the use of water potential is not correct or is not included*

water moves into root hair cells ;

through partially permeable cell surface membrane ;

through, protein pores / aquaporins ;

by osmosis ;

down a water potential gradient / from the soil which has a high(er) water potential to the root hair that has a low(er) water potential ; [4]

d) sea water has higher concentration of, solutes / ions, than soil water ;

lowers the water potential of the soil after flooding ;

most plants are not adapted to, high salt content of soil / low water potential of soil ;

plants do not absorb much water / rate of water absorption decreases ;

as the roots do not have a lower water potential than the soil ;

may even lose water to the soil down a water potential gradient ;

although aquaporins (channel proteins for movement of water) in plasma (cell surface) membranes close to prevent this ;

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see page 95 for a diagram showing an aquaporin

rate of, water loss / transpiration, is greater than rate of, water absorption / supply of water by the xylem ;

leaf cells lose water and become flaccid (so plant wilts) ; [5]

[Total: 17]

4 A [1]

5 **a)** *mature phloem sieve tube elements*

are living cells ; *mature xylem vessel elements cells are dead*

have cell contents / described ; *xylem vessel elements are empty*

thinner cell walls ; *xylem vessel elements have thick cellulose cell walls*

no lignin ; *xylem vessel elements are thickened with lignin*

perforated end walls / sieve plates ; *many xylem vessels do not have perforated end walls* [4]

b) protein pumps in cell surface of companion cells ;

pump, hydrogen ions / H^+ / protons, out of companion cell (against concentration gradient into cell wall not into sieve tube) ;

<u>active transport ;</u>

using, ATP / energy (from respiration) ;

builds up a, hydrogen ion / proton, gradient (back into cell) ;

(facilitated) diffusion of hydrogen ions and sucrose through co-transporter (membrane) protein ;

diffusion of sucrose (from companion cell) into sieve tube ;

via plasmodesmata ; [5]

c) mass flow / pressure flow ;

sucrose / assimilates, in sieve tube (elements) in, source / leaf ;

decreases the water potential ;

water diffuses in from, surrounding tissue / xylem ;

increases the hydrostatic pressure (in source) ;

forces sap through sieve tubes (towards sink) ;

sucrose unloaded at sink (into surrounding tissue) ;

lowers water potential in surrounding tissue ;

water diffuses out down a water potential gradient ;

decreases hydrostatic pressure (in sink) ; [5]

d) substances transported in phloem from <u>source</u> to <u>sink</u> ;

during growing season / when photosynthesising / when assimilates are made ;

substances are transported from leaves down, to roots *or* to (named) storage organ / to be stored ;

transported from leaves up to the, growing points (meristems) / flowers / fruits / seeds / new leaves / AW ;

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at the time of year when, no / little, photosynthesis ;

substances are transported upwards from, roots / storage organ / seed ;

e.g. during germination ; [5]

[Total: 19]

6 a) i) evaporation of water, from (surfaces of) mesophyll ;

diffusion of water vapour ;

from, leaves / aerial parts of a plant ;

through stomata ; (not from stomata) [3]

ii) mesophyll cells are the site of photosynthesis ;

absorption of carbon dioxide occurs on cell surface of each cell ;

no specialised gas exchange surface ;

no system for transporting carbon dioxide throughout the plant ;

cell surfaces / cell walls, of mesophyll cells are damp ;

water evaporates from these surfaces ;

diffusion of carbon dioxide into the leaf occurs through stomata ;

when stomata are open water vapour diffuses out of the leaf down a water potential gradient; [5]

b) evaporation / transpiration, causes movement of water ;

in xylem ;

any adaptation of xylem ;

e.g. empty / no cytoplasm / no end walls / wide

transpiration, reduces pressure at the top of the plant / gives rise to a water potential gradient ;

transpiration pull ;

maintained by cohesion between water molecules ;

cohesion explained in terms of hydrogen bonding between water molecules ;

cohesion maintains a continuous column of water / AW ;

supported by adhesion of water / AW, to walls of xylem ; [6]

c) cut transverse section at intervals along the stem ;

cut longitudinal sections ;

along areas stained by paint ;

used microscope to see cell types that had been, stained / coated, by the paint ;

compared sections (TS and/or LS) with sections to show location of different tissues, e.g. cortex, phloem and xylem ;

use of differential staining / described, to show differences between plant tissues in reference sections ; [4]

[Total: 18]

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7 *description of the results*

- in well watered conditions clone 1 has a higher mean rate of transpiration than clone 2
- in first period (days 25-57) and in the second (days 62-89)
- e.g. clone 1 33.74 g v clone 2 21.41 g *or* clone 1 57.21 g v clone 2 37.38 g
- little difference between clones 1 and 2 in conditions of water stress during first period
- greater difference between clones 1 and 2 in mild water stress in second period
- rate of clone 2 is half that of clone 1
- little difference between clones 1 and 2 in severe water stress in both periods
- e.g. clone 1 10.66 g v clone 2 11.58 g *or* clone 1 12.98 g v clone 2 11.58 g

conclusions

- both clones reduce water loss considerably in conditions of water stress
- clone 2 adapts better to mild water stress than clone 1
- physiological suggestion for difference

e.g. possible differences in, leaf surface area / depth of cuticle, mass of plants, water potential when wilting occurs

- no difference in ability to reduce rate of transpiration in severe water stress

evaluation

- data only provided with mean values
- no data for the individual seedlings
- no indication of variation in rates of transpiration within each clone
- e.g. no standard deviation / ranges of rates of transpiration (minimum and maximum in each group)
- no information as to whether the environmental conditions were the same over both time periods

statistical test

- if given standard deviations could use the *t*-test
- to compare differences between the clones in the same conditions in same time period
- to compare differences between seedlings of the same clone in different periods
- to compare differences between seedlings of the same clone in different conditions
- with 30 plants in each group there is a sufficiently large number to use the *t*-test

8 This question highlights the importance of choosing a suitable parameter to investigate. The details of the plan depend on the parameter chosen as the independent variable.

For example, you could try to find out what proportion of water in the xylem and/or assimilates in the phloem are taken by dodder growing on a plant like *Coleus* or *Impatiens*.

This might be very difficult to do. So it might be more realistic to look at the effect of the parasite on the growth of the plants and choose a parameter that is easier to measure.

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Growth can be measured by recording increase in height or numbers of leaves, but usually it is assessed by measuring increases in dry mass. This means harvesting host plants at regular intervals and drying them. The plan needs to make it clear that a large number of host plants are needed as 10 or so are going to be killed at each sampling time. This was not necessary in the case of the *Eucalyptus* seedlings in Q.7 as measurements of rates of transpiration were not destructive and it was not necessary to harvest and kill the plants at intervals.
The rate of growth of the host plants parasitised by dodder could be compared with the growth of control plants of the same species that are not parasitised. All other conditions would have to be kept constant e.g. species of dodder, the watering regime and the environmental conditions
Two groups of host plants will be needed – an experimental group that is parasitised by dodder and an unparasitised group as the control group.

If results for ten or more plants are collected, then the results can be analysed by calculating means and standard deviations. The Student's t test can be used to find out if the difference between the means of the experimental and control groups is statistically significant.

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